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XIV. *Observations on the Human Urethra, showing its internal structure, as it appeared in the Microscope of F. BAUER, Esq.*
By Sir EVERARD HOME, Bart. V. P. R. S.

Read June 1, 1820.

THE smallest additions to our knowledge of Human Anatomy, have ever met with the most liberal reception from the Royal Society. Such communications must necessarily be of rare occurrence, the field having not only been gone over so often, but cultivated with the utmost labour and zeal, by men of the highest talents, and most acute discernment. Much, however, is still wanting to make us acquainted with the internal structure of all the organs of the human body ; and some of those not yet thoroughly examined, are of very great importance, not only on account of the functions they perform, but the diseases to which they are liable ; since by these diseases the natural functions are disturbed, and occasionally completely interrupted ; and when that happens, the life of the patient is too often destroyed.

The structure of the human urethra, as far as it could be examined by ordinary vision, assisted by glasses of small magnifying power, has been long known to all the anatomists of the present day ; and twenty-five years ago I thought myself thoroughly acquainted with it ; but I now find that I was wholly ignorant of the more minute parts of its conformation.

For the knowledge I have now acquired, which it is the

the object of this paper to communicate to the Society, we are indebted to Mr. BAUER, who has given the most patient and laborious attention to the examination of these parts, magnified in different ways, and has faithfully represented them as they appeared to his view.

From Mr. BAUER's examinations, we find that the human urethra is made up of two parts, an internal membrane, and an external muscular covering.

The internal membrane is exceedingly thin, and no fibres are met with that can give it a power of contraction. When it is put on the stretch in a transverse direction, the circumference of the canal is no ways encreased; but when stretched longitudinally, a small degree of elongation is produced.

When a transverse section of the urethra is made while in a collapsed state, the internal membrane is found thrown into folds pressed together by the surrounding parts. This appearance is shown in the most satisfactory manner in the annexed Plates.

On the surface of the internal membrane, over which the urine passes, there are numberless small projections, or papillæ, the orifices of glands. The surface is covered with small blood-vessels, and the lacunæ leading to the deeper seated glands, are very numerous. These parts are beautifully represented in Plate XXI. Fig. 4, in a small portion of the lining of the urethra, near the external orifice, minutely injected, magnified ten times in diameter.

The muscular covering by which the membrane is surrounded, or enclosed, is made up of fasciculi of very short fibres, which appear to be interwoven together, and to be

connected by their origins and insertions with one another ; they all have a longitudinal direction. A muscular structure of this description, as far as I know, is not met with in any other part of the body. It is however to be observed, that there is no other instance in which fibres of such minuteness have been examined, and faithfully represented.

There is a greater thickness of this muscular structure upon the upper, than the under surface of the urethra, which is still more evident, as it approaches nearer to the external orifice. The fasciculi are united together by an elastic substance of the consistence of mucus. This muscular structure is represented in a longitudinal section of a portion of the corpus spongiosum urethræ, magnified fifteen times in diameter. The internal structure of these fasciculi is shown in Pl. XXIII. Fig. 2, 3, magnified twenty-five diameters, and in Fig. 4, magnified fifty diameters. In this Plate the fasciculi are thickened in consequence of inflammation. Immediately beyond the muscular portion of the urethra, is the cellular structure of the corpus spongiosum.

This mechanism, which forms the canal of the urethra, is very different from what it has hitherto been contemplated to be, and therefore a knowledge of it enables us to correct many errors that we had fallen into with respect to the actions of its parts, both in a healthy state, and when under the influence of disease.

Till now it was believed, that either the lining of the urethra was composed of circular fibres, possessed of a power of contraction, or that it was immediately surrounded by such fibres ; and therefore, that the disease commonly known by the name of a stricture in the urethra, was produced by a

contraction of some of these circular fibres; and that permanent stricture was a term applied to these parts, when, in consequence of inflammation, they became confined to that particular state.

We now find from the annexed Plates, that the lining of the urethra is never met with in a contracted state, but is thrown into folds by the action of the elastic ligamentous covering of the corpus spongiosum, and the swell of the longitudinal muscular fibres within it; and when these fibres have, by acting through their whole length, reduced the urethra to its shortest state, the pressure upon the internal membrane is so great, that there is not room for the urine to pass till these fibres are relaxed by elongating the whole canal.

A spasmodic stricture is in reality a contraction of a small portion of the longitudinal muscular fibres, while the rest are relaxed; and as this may take place either all round, or upon any one side, it explains what is met with in practice, and which could not be satisfactorily accounted for; the mark or impression of a stricture sometimes forming a circular depression upon the bougie, at others only on one side.

A permanent stricture is where, in consequence of inflammation, coagulable lymph is exuded, between the fasciculi of muscular fibres, and upon the internal membrane, in different quantities according to circumstances; and in the same proportion diminishing the passage for the urine at that part, or completely closing it up. The changes the parts undergo in the formation of a permanent stricture, are most satisfactorily shown in Pl. XXII. XXIII.

In this investigation, Mr. BAUER's examinations have not been confined to the canal of the urethra; he has, at my

request, extended them to the corpus spongiosum, and to the corpora cavernosa ; respecting the structure of which, even at this day, different opinions are entertained by some of the most celebrated physiologists in Europe.

When these bodies are entirely empty and collapsed, as we generally find them in the dead body, they contract so much from their elasticity, as to make it next to impossible to examine the structure of their different parts ; and no inconsiderable art and contrivance becomes necessary, so to prepare them, that the internal structure, may be sufficiently displayed, to render the examination satisfactory. Every attempt to make the substances commonly used as injections, pass from the arteries into the cellular internal structure, proved ineffectual ; that mode therefore of distending those cells was soon abandoned ; injecting them directly by puncturing the surrounding coverings, could not give them their natural appearance ; we therefore did not avail ourselves of it. The only mode of expanding the internal structure, at the same time that it was not disturbed, was to fill it through the medium of its own arteries, and then, by hardening the parts in spirit, preserve them in a distended state.

This was done in three different ways. In one instance they were found filled naturally, by the blood that had been retained there, and which, in the act of dying, had not been expelled, as in Plate XVIII.

In another, proof spirit was injected by the arteries till all the internal cellular structure was distended by it ; and this spirit was retained there, as in Plate XIX.

In a third, the arteries were injected with quicksilver, which readily passed into the internal parts, and was retained

there by plugging up the trunks with common injection. The parts were then dried, and put into oil of turpentine. When preserved some time in that state, a longitudinal section of one of the corpora cavernosa was made, as in Plate XX, and the quicksilver allowed to run out. The preparation thus made is in the Collection of the Royal College of Surgeons in London; one of the many valuable donations made to that Museum by Sir WILLIAM BLIZARD. The others were made upon this occasion.

From these preparations, the fact is sufficiently established, that the cellular internal structure of the corpora cavernosa and corpus spongiosum, receives the blood into its cavities directly from the smaller branches of the arteries with which these parts are provided; but the nature of this structure remains to be explained.

It was found by Mr. BAUER, from an examination of these different preparations, that the cellular structure of the corpora cavernosa is made up of an infinite number of thin membranous plates, exceedingly elastic, so connected together as to form a kind of trellis work, the edge of which is firmly connected with the strong elastic ligamentous substance by which these bodies are surrounded, and which forms a septum between them, separating them from one another. This substance has an intermixture of muscular fibres. The septum has not the same appearance in different individuals; in some, it is much thicker than in others; and towards the anterior end, in one preparation, was almost entirely wanting; as in Plate XVIII, Fig. 2.

In the central line of each corpus cavernosum there is an open space. This is of considerable length, but is by no

means equally so in different instances. This has no regular boundary, and appears to be formed simply by the elastic plates being wanting. These plates, from their extreme elasticity, are with difficulty examined; but as it appeared that their structure is the subject respecting which physiologists are not agreed, Mr. BAUER spared no pains, and exerted his ingenuity in putting them to the test of different modes of examination on the field of the microscope, and is perfectly satisfied that they are what he has represented them to be; namely, simple thin membranous elastic plates, not made up of more than one layer, not having a cavity between them, nor in any way forming regular cavities, but having irregular interstices: they vary in size considerably in different parts of the same body. It is into these interstices that the blood is occasionally received from the termination of the small arteries which are every where branching upon, and supported by, the elastic plates of which the trellis work is composed; as in Pl. XVIII, Fig. 1. Pl. XIX, Fig. 1. Pl. XX, Fig. 1.

The circulation of the blood in these parts being different at different times, is a most beautiful illustration of the fact, which upon a former occasion I communicated to the Society; namely, the great influence the nerves have upon the action of the smaller arteries, as well as on their larger trunks. When the nerves that supply the corpora cavernosa and corpus spongiosum, (and they are very numerous,) are not affected by the state of mind of the individual, the blood is not carried into this trellis work, but returns by the veins, as in other parts of the body; but when the mind receives such impressions as excite these nerves, the smaller arteries have their action so much

increased, as not only to pour the blood into the interstices, and the open space which they inclose, but to distend them, overcoming the elastic power that, under ordinary circumstances, keeps them collapsed.

The corpus spongiosum differs in nothing from the corpora cavernosa, but in the parts being formed upon a smaller scale; there being no open space in the middle or central line of the trellis work; and the ligamentous elastic covering which surrounds it, having no muscular fibres intermixed with its substance. When a transverse section of the corpus spongiosum is examined in the microscope, the orifices of six or seven divided arterial trunks are distinctly seen in different parts of the section, as in Pl. XXI, Fig. 1.

As the corpus spongiosum may be said to be continued into, and to form the glans, the internal structure of which is of the same kind, I was desirous that Mr. BAUER should examine the covering of that body in the microscope, to ascertain whether there were any papillæ upon its surface, so different from those of the skin generally, as to account for this part having a sensation peculiar to itself, and as unlike the common feeling of touch, as the sense of taste, which is peculiar to the tongue; this last I have explained upon a former occasion to the Society, is confined to the tip; since, when the sense of taste is destroyed by the nerves that produce it being injured, the common sensations of the rest of that organ, as well as its voluntary motions, are as perfect as before.

From the annexed magnified representations of a portion of the glans, showing the papillæ on its surface, it is evident that such a peculiar organization must be constructed to produce a more than ordinary delicate sensation. Pl. XXI, Fig. 5, Fig. 6.

Fig. 1.

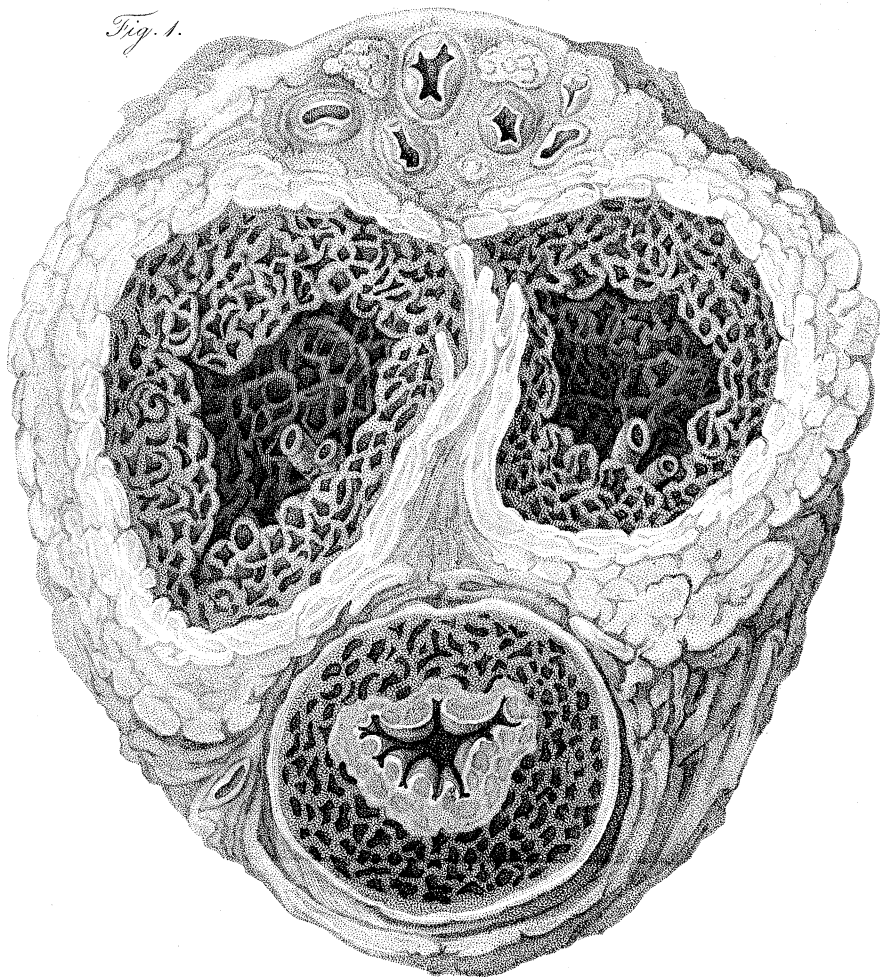
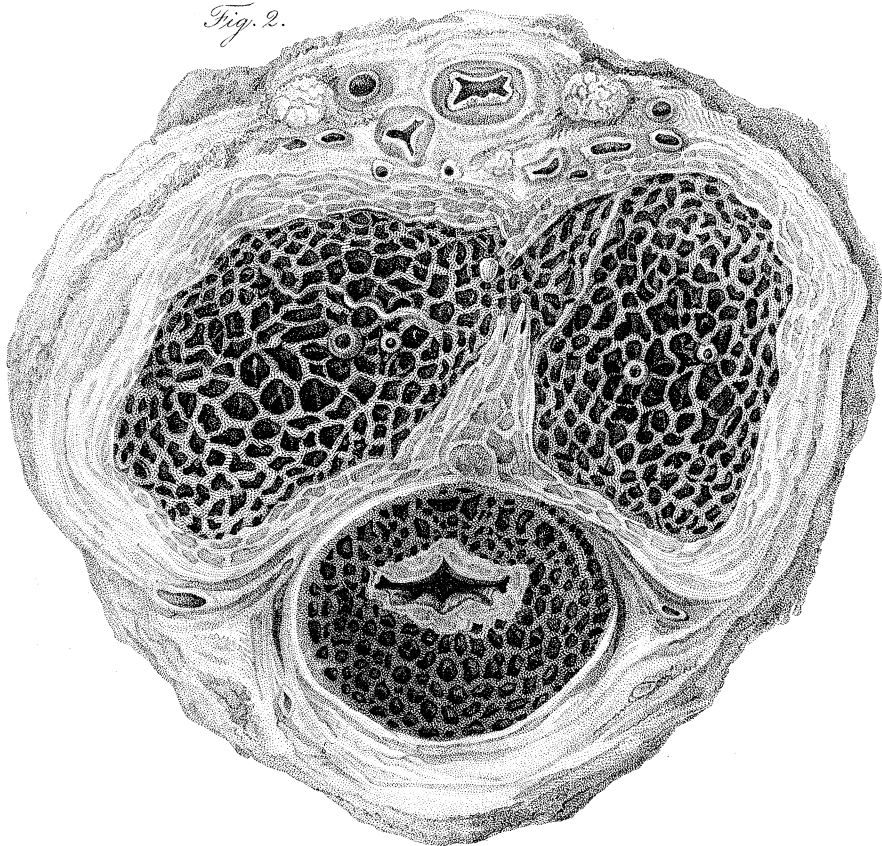


Fig. 2.



To describe the appearance which is so beautifully represented in the drawing, would be trifling with the time of the Society; and I am afraid that I have already allowed myself to say much more upon several of the other subjects contained in this paper than was necessary, illustrated as they are by Mr. BAUER's drawings.

EXPLANATION OF THE PLATES.

PLATE XVIII.

Consists of two figures or transverse sections of the same penis, magnified four times in diameter.

Fig. 1. Shows the internal structure of the corpora cavernosa near the middle of the penis, where the central part is one general cavity, surrounded every where by the open trellis work; the interstices are filled with coagula of the blood they contained at the time of the person's death; the divided trunks of the arteries which supplied the blood are very distinct.

Upon the dorsum penis are seen the divided arteries which lie there, imbedded in the elastic ligamentous and muscular substance, by which the corpora cavernosa are covered, and which is continued between them, forming the septum; it also completely surrounds them.

The cellular structure of the corpus spongiosum forms a similar trellis work upon a smaller scale; the urethra passes through it rather above the centre. The lining is thrown into folds, and the opening, which is closed, is flattened, being more compressed from above and below than laterally.

Fig. 2. The same parts shown in a section nearer the glans. The trellis work here is more distended with blood.

In this section the septum is in part wanting, the muscular coat of the urethra is thinner, and there is no open space in the centre of the corpora cavernosa.

PLATE XIX.

Consists of four figures, taken from a penis in which the corpora cavernosa and corpus spongiosum had been injected by the arteries with spirit, and then allowed to harden in spirit; the urethra had also been injected with spirit, and kept distended.

Fig. 1. This section was taken near the root. The parts are nearly the same as in the last Plate; they are only magnified two diameters.

Fig. 2. A very small portion of the trellis work of one of the corpora cavernosa of the same section; magnified fifteen times in diameter.

Fig. 3. Another transverse section nearer the glans, magnified two diameters. In this the cavity in the corpora cavernosa is seen, and the membrane of the urethra is thrown into folds.

Fig. 4. A very small portion of the last section; magnified fifteen times in diameter.

PLATE XX.

Consists of three figures, taken from a penis, the corpora cavernosa of which were injected with mercury by the arteries, and the mercury was retained there by plugging up the trunks with common injection. The parts were then dried, and a longitudinal section made so as to let the mercury escape and leave the trellis work empty. In this state the preparation is kept in oil of turpentine.

Fig. 1.

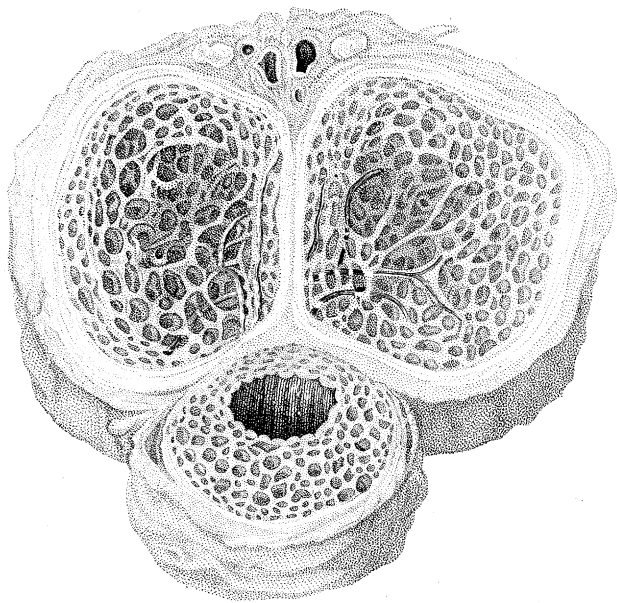


Fig. 2.



Fig. 4.

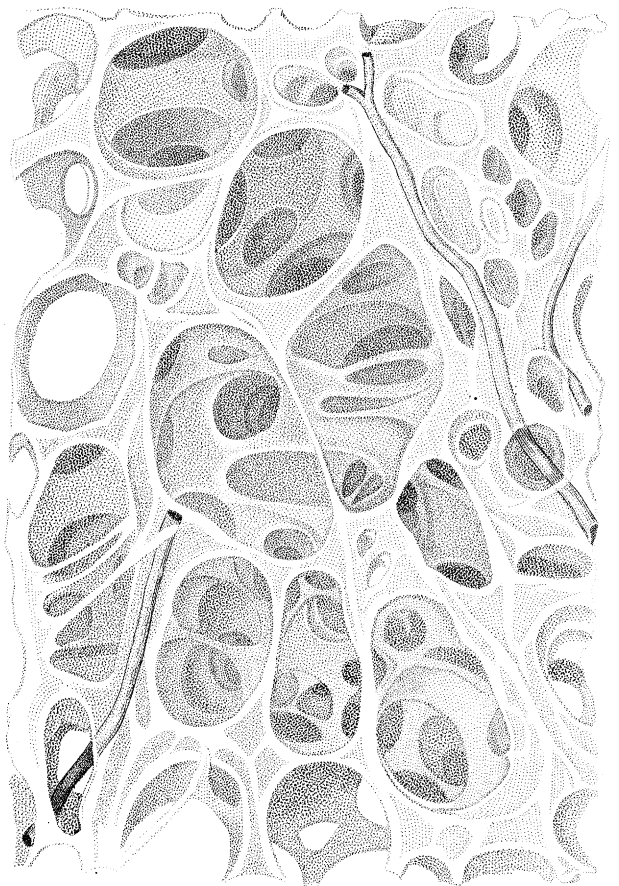


Fig. 3.

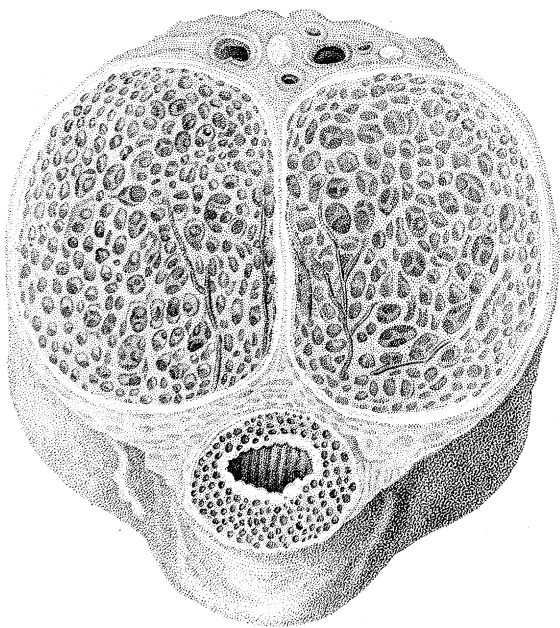
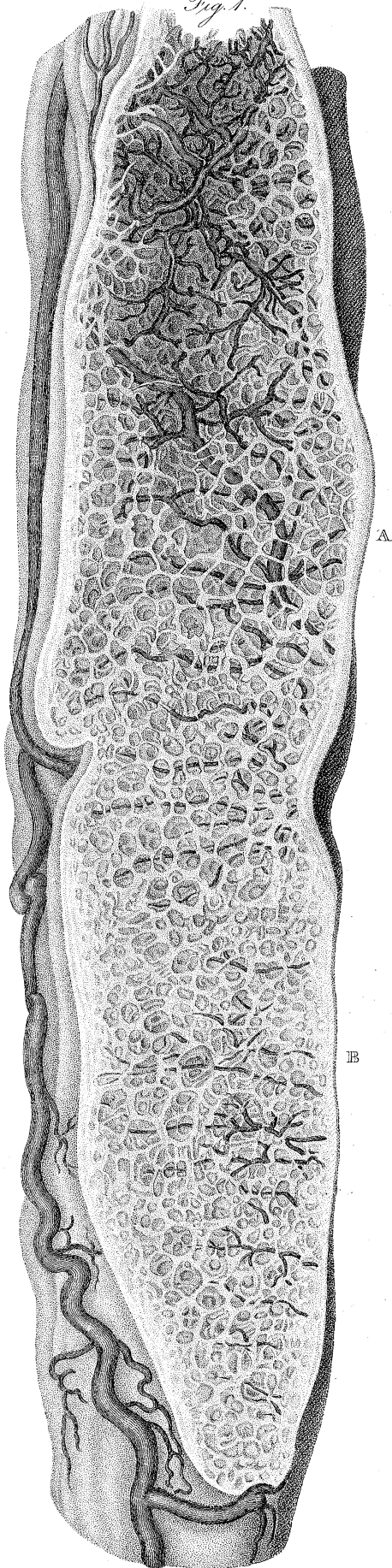


Fig. 1.



A.

B.

Fig. 2.

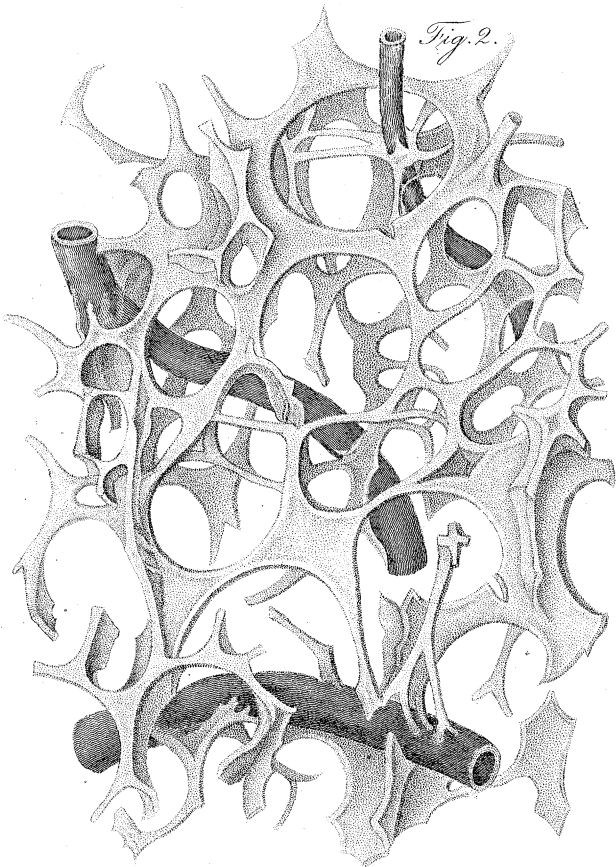


Fig. 3.

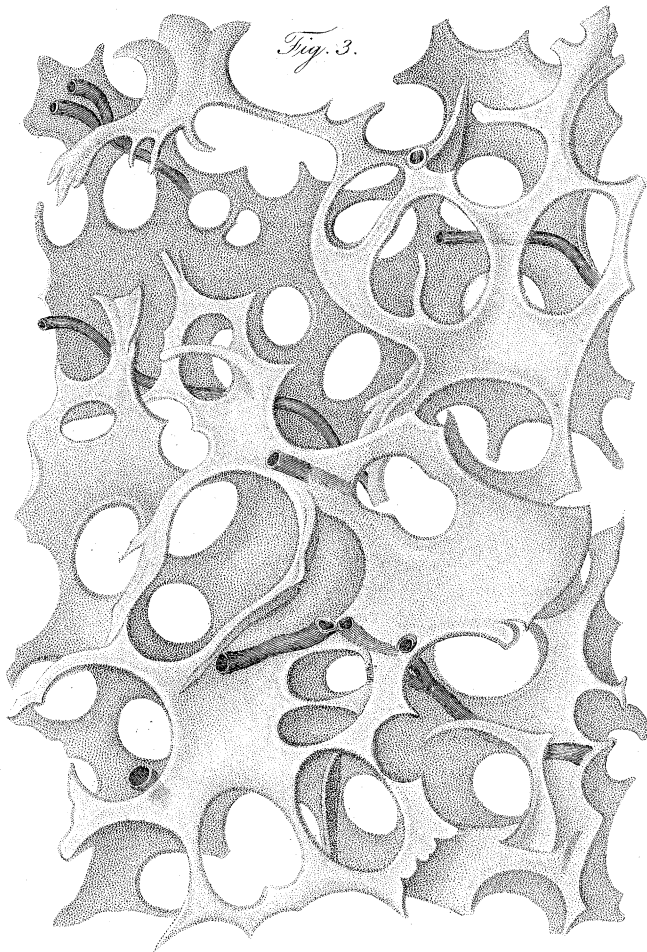


Fig. 1.

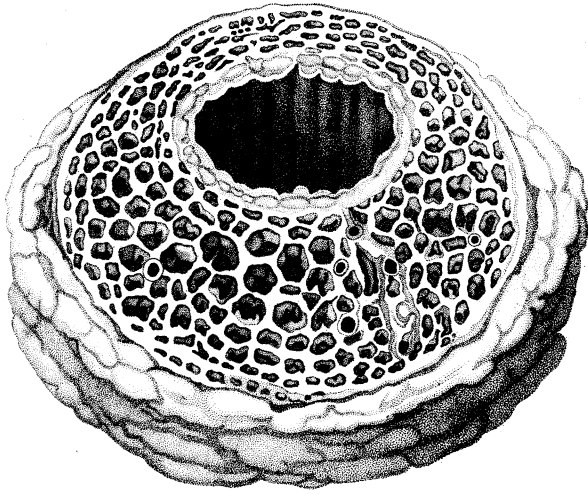


Fig. 2.

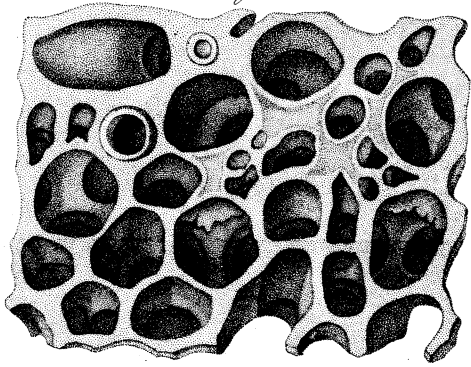


Fig. 5.

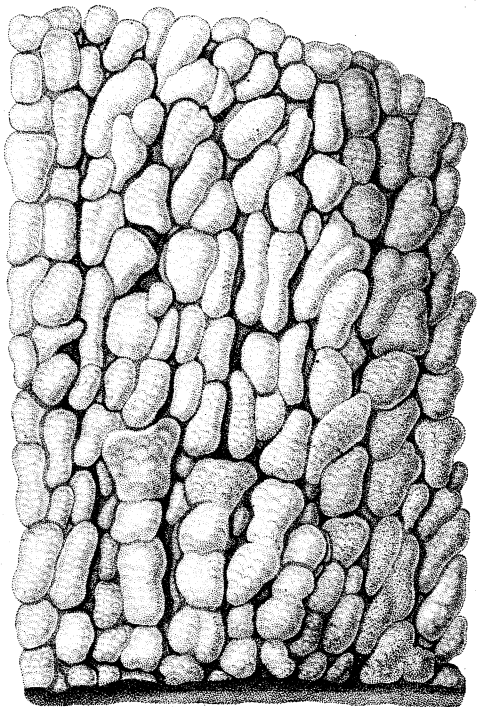


Fig. 3.

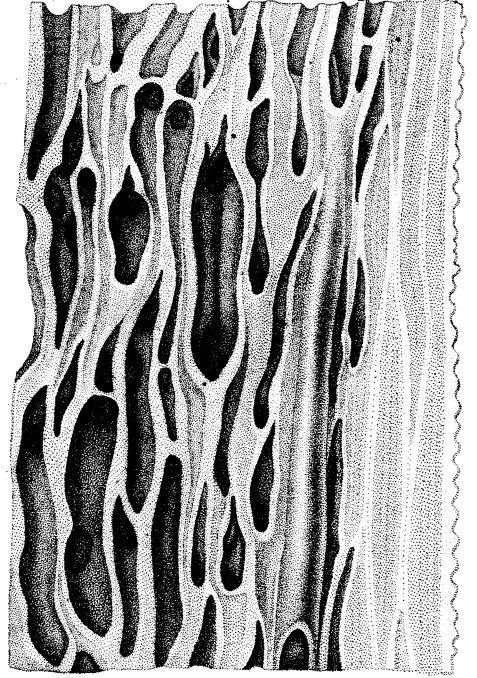


Fig. 4.

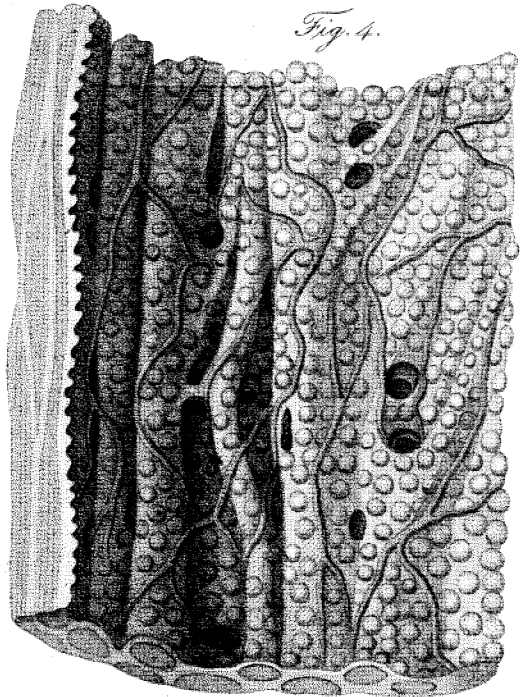


Fig. 6.

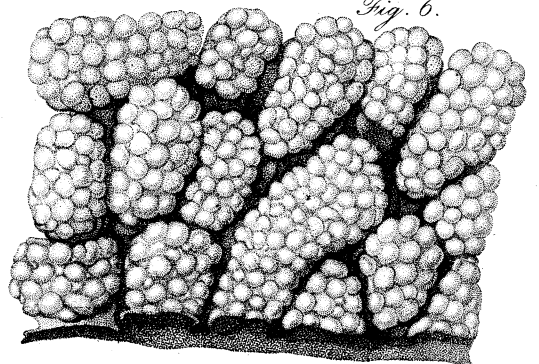


Fig. 1. A longitudinal section of one of the corpora cavernosa, showing the course of the artery, branching through the trellis work. The part at A, has the central cavity exposed. This section is magnified two diameters.

Fig. 2. A very small portion of the cellular substance of the same longitudinal section, taken from the part at A; magnified fifteen times in diameter.

Fig. 3. A small portion near B; magnified fifteen times in diameter.

PLATE XXI.

Consists of six figures, three of the corpus spongiosum urethræ, one of the internal membrane of the urethra, and two of the villi of the covering of the glans penis.

Fig. 1. A transverse section of the corpus spongiosum urethræ, taken from the same penis as Plate XIX, Fig. 1. magnified four diameters, to show the parts more distinctly, particularly the sections of the arteries going to the trellis work.

Fig. 2. A small portion of the transverse section, Fig. 1, magnified fifteen diameters, to show the trellis work in the corpus spongiosum.

Fig. 3. A longitudinal section of the same corpus spongiosum and muscular coat of the urethra; magnified fifteen times.

Fig. 4. The internal membrane with the glands upon its surface, and the lacunæ; magnified ten diameters.

Fig. 5. The covering of the glans penis for the papillæ; magnified ten diameters.

Fig. 6. A smaller portion; magnified twenty-five diameters.

PLATE XXII.

This Plate contains two figures, giving different views of a stricture in the urethra. The stricture had become so narrow, that a piece of gravel was prevented from passing, and had imbedded itself in a cul de sac immediately behind the stricture. This piece of gravel increased in size by receiving additions from the urine that passed over it; and the stream, every time of making water, turning it round in its bed, it acquired a spherical form. The patient never having had any attempts made for his relief, and being seized all at once with a complete suppression, died; after death, the calculus was found closing up the orifice of the stricture. Both figures are magnified five diameters.

Fig. 1. A transverse section of the urethra a little beyond the stricture, showing from behind the aperture which the stone closed up, and giving a side view of the cul de sac in which it had usually remained. This cavity is not made by a fold of the internal membrane, but by an exudation of coagulable lymph forming a sac.

The other parts are the same as have been already described in the transverse sections of the urethra, in a natural state.

Fig. 2. Represents the urethra laid open from above, in a longitudinal direction. The right hand portion exhibits the newly formed coagulable lymph produced by the irritation of the stone; the serrated processes of coagulable lymph projecting from the internal membrane, which is itself thickened, and pressed forward by the swell of the muscular structure surrounding it, are also distinctly seen. The na-

Fig. 1.

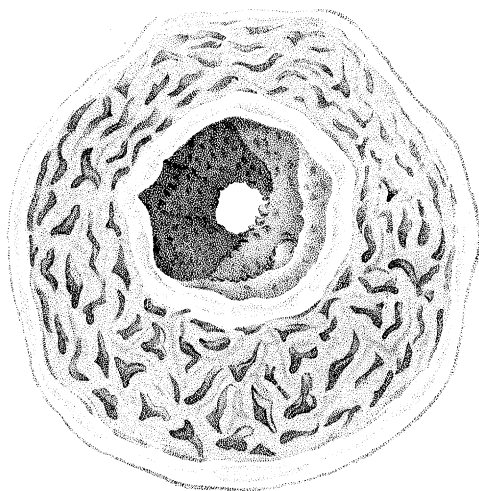


Fig. 2.

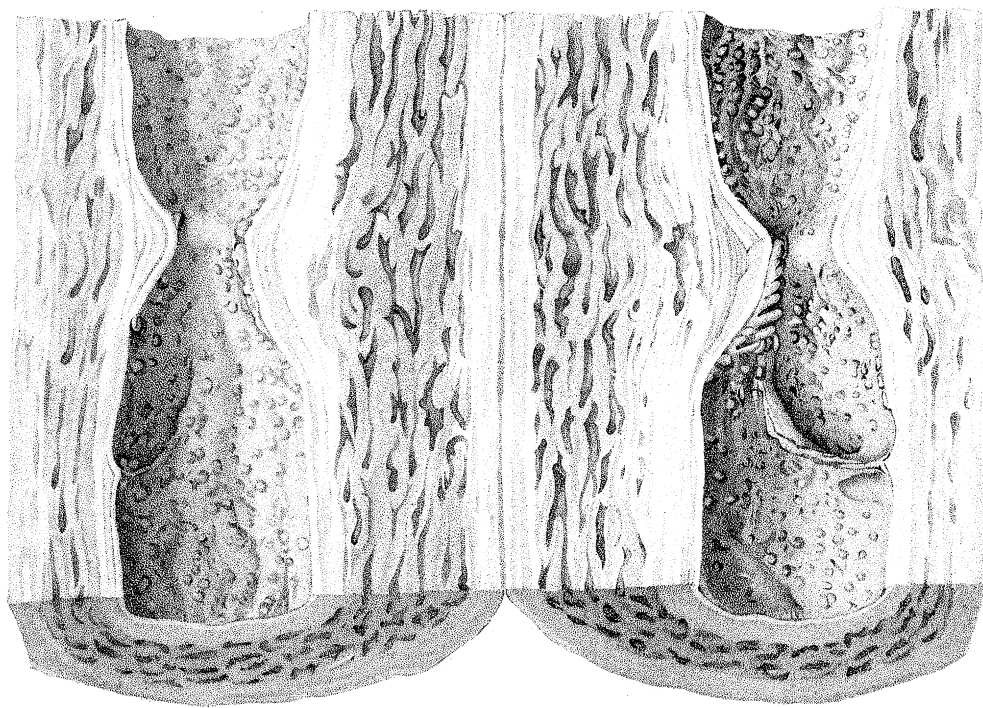


Fig. 1.



Fig. 2.

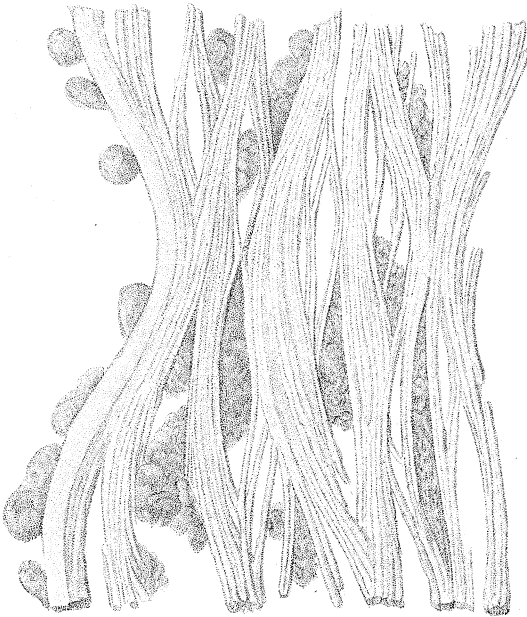
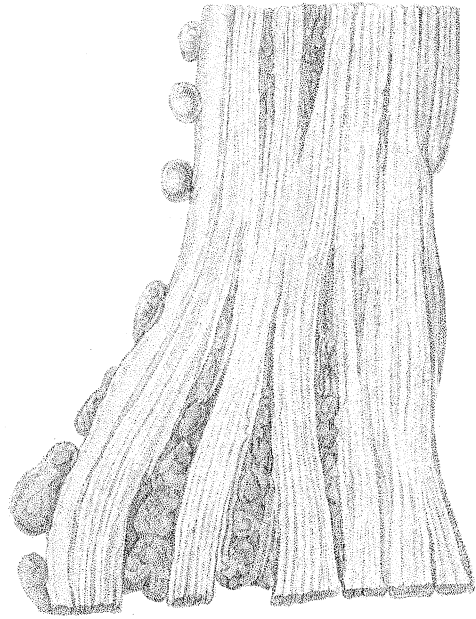


Fig. 3.



Fig. 4.

tural granulated structure of the internal membrane is increased in size by the effects of inflammation. Besides which, there are small globular exudations of coagulable lymph, like studs, on different parts of the surface.

PLATE XXIII.

This Plate contains four figures, representing the internal membrane, and the muscular structure surrounding it, at the strictured part. The three first figures are magnified twenty-five diameters, the fourth fifty.

Fig. 1. Shows the exudations of coagulable lymph in masses of different forms and sizes, and the enlarged glands, nearly uniform in their shape, and of a smaller form.

Fig. 2. Shows the longitudinal muscular fibres, and the masses of coagulable lymph deposited between the fasciculi, increasing the volume so much, as to produce the narrow aperture or stricture.

Fig. 3. The same muscular fibres, having the fasciculi more separated from one another.

Fig. 4. The same fasciculi separated still more, and nearly into their ultimate fibres.